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Water and Environment Support
in the ENI Southern Neighbourhood region

Activity No: N-W-EG-2

Assist Egypt in the development of financing mechanisms, allowing the private sector to be involved and improve "water network management and resources efficiency at the on-farm level"

Task 1: Review of existing financing mechanisms and PPP framework in Egypt

Deliverable 1: Summary of findings, evaluation and recommendations

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v.1	*Summary of findings and best practices and prepare recommendations DRAFT 1*	*Khaled El Sayed* *Kees Lakerveld*	

WATER AND ENVIRONMENTAL SUPPORT IN THE ENI SOUTHERN NEIGHBOURHOOD REGION

The "Water and Environment Support (WES) in the ENI Neighborhood South Region" project is a regional technical support project funded by the EU (DG NEAR) for the support of the countries of the ENI Southern Neighborhood Region in addressing critical Environmental and Water issues. WES will contribute to more efficient management of scarce water resources in the Neighborhood South region. We will do so by increasing the capacity of stakeholders involved in pollution reduction and water management. Amongst others, WES will support them in formulating and implementing environmental and water policies. Furthermore, WES will contribute to the reduction and prevention of pollution in the Mediterranean region, limit marine litter, support the shift to a sustainable consumption and production model, implement integrated management of water resources, and strengthen efficient use of water. WES builds on previous similar regional projects funded by the European Union (Horizon 2020 CB/MEP, SWIM I and II, SWIM-Horizon 2020 SM) and strives to create a supportive environment and increase the capacity of all stakeholders in the partner countries (PCs). The WES PCs are Algeria, Egypt, Israel, Jordan, Lebanon, Morocco, Libya, Palestine, Syria and Tunisia. However, to ensure the coherence and effectiveness of EU funding or promote regional cooperation, the eligibility of specific actions will be extended to neighbouring countries in the Southern Neighborhood region.

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ABBREVIATIONS

ABE	Agricultural Bank of Egypt
ADP	Agricultural Development Program
BCWUA	Branch Canal level Water Users Associations
CBE	Central Bank of Egypt
CIB	Commercial International Bank
EGP	Egyptian pound
ENI	European Neighborhood Instrument
FAO	Food and Agriculture Organization
FIMP	Farm-level Irrigation Modernization Project
GOE	Government of Egypt
IFAD	International Fund for Agriculture Development
IFC	International Finance Corporation
IIP	Irrigation Improvement Project
MALR	Ministry for Agriculture and Land Reclamation
MOF	Ministry of Finance
MOP	Ministry of Planning
MWRI	Ministry of Water Resources and Irrigation
NBE	National Bank of Egypt
OFIDO	On-Farm Irrigation Development in the Old Lands
OFIDP	On-Farm Irrigation Development Project
PCs	partner countries
SMEs	Small and medium-sized enterprises
SFD	Social Fund for Development
WES	Water and Environment Support
WUAs	Water Users Associations

EXECUTIVE SUMMARY

The main objective of this review was to provide a better understanding of Egypt's existing government-backed financing mechanism and the current Egyptian Public-Private Partnership (PPP) framework for the water sector in general, including irrigation projects considering institutional/legal aspects such as procurement law, PPP law and public/private financing mechanisms. This understanding was required to examine the effectiveness of the applied mechanism in Egypt related to financing irrigation investments and modernization of on-farm irrigation methods/equipment specifically and water projects in general.

For this review, a local expert, Dr Khaled El Sayed, supported us in collecting all the necessary information to execute this task.

The outcome of the review:

1. In this detailed assessment of the existing (public) financing modalities in Egypt and private sector involvement, we found that a significant change in overall irrigation efficiency will not occur as there is little scope to enhance the overall efficiency. Therefore, farm households or agricultural enterprises will have to reduce their water consumption by 10%, which is challenging due to the expected rise in temperature. Farmers will have to choose crops or cultivation systems that consume less water.
2. Insight into the Egyptian Public-Private Partnership framework and how it facilitates (irrigation) procurement and investment.
3. Effectiveness of the applied methods (on-farm).
4. Differences and best practices of the methods applied.
5. Recommendations for improvement concerning financing and transactional support and the preconditions in terms of the enabling environment.

1. BACKGROUND INFORMATION

1.1 INTRODUCTION TO THE PROJECT

The "Water and Environment Support (WES) in the ENI Neighborhood South Region" project is a regional technical support project funded by the European Neighborhood Instrument (ENI South). WES aims to protect the natural resources in the Mediterranean context and improve the management of scarce water resources. WES mainly aims to solve the problems linked to pollution prevention and the rational use of water.

WES builds on previous similar regional projects funded by the European Union (Horizon 2020 CB/MEP, SWIM SM and SWIM-Horizon 2020 SM) and strives to create a supportive environment and increase all stakeholders' capacity of the partner countries (PCs).

The WES Project Countries are Algeria, Egypt, Israel, Jordan, Lebanon, Morocco, Libya, Palestine, Syria and Tunisia. However, to ensure the coherence and effectiveness of EU funding or to promote regional cooperation, the eligibility of specific actions can be extended to neighbouring countries in the Southern Neighborhood region.

1.2 GENERAL BACKGROUND OF THE ACTIVITY

BACKGROUND

The Arab region where Egypt is located has the lowest per capita fresh-water resource availability globally (10 % of the world average). In the last 40 years, available fresh water has decreased by two-thirds. By 2025, it is expected to decline a further 50 percent. The climate is semi-dry, and Egypt relies on irrigated farming for food security. In that region, agriculture consumes more than 80% of water resources. Some reasons for this are externalities such as climate change hitting hard with decreased rainfall and warmer temperatures and inefficiencies upstream in the Nile Basin, which supplies some 95% of Egypt's freshwater. Typically, irrigation systems comprise primary (main) canals that convey water from a resource to an integrated area, secondary (branch) canals that deliver water from a primary canal to different parts of the area, and tertiary canals that distribute water to individual farms. According to FAO AQUASTAT1, in 2015, total irrigation in the region was 19,207,142 ha, surface irrigation, sprinklers, and drip irrigation accounted for about 85 %, 10 % and 5%, respectively.

Solutions to such problems are likely to prove challenging and require robust water diplomacy. In addition, Egypt faces a range of internal challenges, including:

1. Increased crop water requirements;
2. population growth;
3. the relationship between sustained economic growth and industrial demand for water;
4. increasing pollution from agriculture, industry, and domestic sanitation and refuse disposal; and
5. Despite some successes, physical and economical water use efficiency levels remain sub-optimal.

Agricultural water is key to achieving several of the United Nations Sustainable Development Goals (SDGs): poverty reduction (SDG 1), food security (SDG 2), and water and sanitation for all (SDG 6). Unless agricultural water is managed sustainably and equitably, the Arab region will struggle to progress these SDGs. Given the sector's importance in supporting agricultural employment and gross domestic product (GDP), addressing the sector's urgent challenges is a priority.

Population growth, climate change, water (and land) scarcity, and shifting consumer preferences drive the need to refurbish food systems at every stage, from seed to table. Investment priorities have shifted: in the 1970s and 1980s, irrigation and drainage infrastructure expansion was the central theme. From the 1990s onwards, there was a move towards investments focused on community-managed systems, modernization and resource management. Among them, modernization has become a key focus of investments and this trend is expected to continue in the coming years.

World Bank estimates the value of the global food system at roughly $8 trillion, or 10 percent of the $80 trillion global economy (REF: World Bank "Do the Costs of the Global Food System Outweigh Its Monetary Value?" https://blogs.worldbank.org/voices/do-costs-global-food-system-outweigh-its-monetary-value). Therefore, applying advanced technology in the agricultural sector has potentially profound implications for producers and investors. Fortunately, technologies and practices make agriculture more climate-smart and environmentally friendly. Besides private bank/sector supports, there are World Bank practices of public financial support to agricultural producers, estimated at nearly half a trillion US dollars annually, where political will is the key for healthier and more sustainable resource transfer. Furthermore, applying new technology through the entire crop production lifecycle ranging from soil preparation to harvestings like robotics to automation and GPS technology has captured public market investor appetite.

The terms of reference (ToR) is focused on challenge number 5, *"physical and economic water use efficiency levels which remain sub-optimal, despite some successes",* and are highly relevant to several outcomes and measures of the country's current National Water Resources Plan (NWRP 2017-2037). Without interventions, Egypt's society, economy, and environment are headed for a situation where growing water scarcity will negatively affect society. As drinking water and industrial water supplies prioritize agriculture, the latter sector's capacity to contribute to the economy and close the food gap will be further challenged. Augmenting supplies and better managing demands will alleviate this situation but cannot avert the negative impacts of growing scarcity. Therefore, adaptation to water scarcity is inevitable. Water scarcity changes the way how government agencies, the private sector, civil organizations, and individual farmers and users of domestic water need to think about water use efficiency.

In view of the above, Egypt has asked the WES Project to implement a national activity entitled: "Assist Egypt in the development of financing mechanisms allowing the private sector to be involved and improve "water network management and resources efficiency at the on-farm level". The activity will contribute "to increase agricultural water productivity" corresponding to the first outcome proposed in the NWRP under the second pillar: "Rationalize Water Use". In addition, it will also contribute to the achievement of the following NWRP-related components:

- Objective 4: "Improve enabling environment for IWRM".

- Measure 4-3-1: "Developing resources to finance water resources projects", for which one indicator is "total investments in water resources financed by the private sector...outside the government budget".

The required activity falls under:

- **Topic 2**: "Water Efficiency Gains at Decentralized Level"
- **Topic 5**: "Enhancing Water Efficiency and Productivity in Agriculture", and the
- **Horizontal topic** "PPP & Access to Investment" and sub-topic 4.1: "Agriculture Water Use Efficiency".

OBJECTIVES

The general objective of the activity is to assist Egypt in developing a financing mechanism to support farmers in purchasing water-saving equipment and enable investments. The goal is to facilitate improved water network management and resource efficiency at the farm level.

The specific objective of this activity, Task 1, is a broad review of the financing mechanisms for purchasing on-farm (drip) irrigation equipment – successes and failures analysis.

2. REVIEW OF EXISTING FINANCING MECHANISMS AND PUBLIC-PRIVATE PARTNERSHIP FRAMEWORK IN EGYPT

This section is further divided into five sub-sections:

1. Existing Government-backed financing mechanism in Egypt where a detailed assessment of the existing (public) financing modalities in Egypt and private sector involvement is mainly delivered
2. Insight into the Egyptian Public-Private Partnership framework, including institutional and legal perspectives and how it facilitates (irrigation) procurement and investment
3. Effectiveness of the applied methods (on-farm).
4. Differences and best practices of the methods applied.
5. Recommendations for improvement concerning financing and transactional support also specifying the preconditions in terms of the enabling environment.

2.1 EXISTING GOVERNMENT-BACKED FINANCING MECHANISM IN EGYPT INVOLVEMENT

As mentioned in recent economic indicators, Egypt's economy gradually turned a corner in the first half of 2017 and continued through 2021. In 2016, the government subjected the economy to shock therapy, which involved floating the pound, cutting fuel subsidies and hiking tariffs, causing inflation to skyrocket. Nevertheless, investors have returned to Egypt, which is indicated by the flood of dollars into the financial system. Egypt's Central Bank reserves have validated these measures, which stand at their highest level since June 2011.

This economic turbulence has forced the Government of Egypt (GOE) to compensate for the adverse effects by creating several stimulus soft loans and backed financing mechanisms in various sectors:

- In December 2015, the Central Bank of Egypt (CBE) announced its initiative to finance small and medium enterprises, for which 200 billion EGP were allocated, with a decreasing interest rate of 5% to support the tourism sector.
- An initiative for real estate finance was created.
- Most importantly, the initiative to finance SMEs is expected to have significant positive effects on the Egyptian economy, in addition to the considerable funding allocated (200 billion EGP).

Financing small and medium-sized enterprises

Egypt started focusing immensely on the SME sector, and Egyptian banks are now using this as the fulcrum of their short-and medium-term strategies. In fact, SMEs may be the best solution for Egypt's challenges, potentially providing jobs to subdue unemployment and substitute imports of finished goods. Additionally, SME projects do not require much capital to finance them, nor do they need advanced labour, organizational expertise, skills, or advanced technology.

The Central Bank of Egypt aims at increasing the SME's lending share of total banks' portfolios to 20% over the next four years. Currently, successive governments and central bank governors have highlighted the importance of extending credit to Egypt's SMEs.

Although lending to SMEs by Egypt's banks is still new, the public sector commercial banks now all offer dedicated SME services. The largest bank, the National Bank of Egypt (NBE), has established an SME division to provide short-term financing of up to a year and funding medium-term (of five to seven years) at soft terms regarding interest rates and guarantees. In addition, the bank is driving SME lending growth by offering small-ticket loans to the informal SME segment as a strategy to deepen its SME portfolio and encourage such businesses to gain access to more extensive credit facilities.

The other **public and commercial banks** are also involved. For example, Banque Misr offers financing of up to 30 million EGP ($4.1m) for medium-sized businesses, with similar maturities to NBE, while small businesses can obtain packages of up to 2 million EGP ($272,600). The largest private institution, Commercial International Bank (CIB), serves the SME industry through its business banking unit. As of 2014, it has managed a portfolio of over 4500 retail companies.

The other large **private sector banks** are increasingly focusing their efforts on the SME segment:

- QNB Alahi offers specialized advisory services in finance, trade finance, investment, and medium-term credit facilities (up to five years).
- Due to the growing demand for SME services, Faisal Islamic Bank's key objective is to increase its SME portfolio.
- Crédit Agricole has operated a dedicated SME division since 2006, and between 2011 and 2014, it increased its SME portfolio by a factor of six to reach EGP 3 billion ($ 408.9 million).
- National Bank of Kuwait caters to the needs of SME clients through its corporate division, offering facilities to fund areas such as working capital needs and trade finance.

- The National Bank obtained a $150 million loan from EERD to finance SMEs in August 2017, Banque Misr received $ 25 million in September 2017, and the Arab African International Bank received $ 30 million in June 2017.
- In addition, the National Bank signed a 50 million (EUR) loan from the German Credit Bank for Reconstruction to finance SMEs.

EU grants and funds are not just limited to the EU. The total funding through this mechanism is estimated to reach about 473 million EUR. The European Bank's Reconstruction Program has allocated about $100 million to Egyptian banks from re-lending to SME projects. Furthermore, direct technical services are provided to ca. 800 small projects, and subsidized services are provided to projects that reach about 25% of their value and are increased to 85% for projects that aim to empower women economically.

Despite the flaws in the formulation of the initiative, Egyptian banks have obtained a nursing year from institutions under the slogan of supporting small and medium enterprises. Furthermore, the CBE decided which exemptions from the reserve ratio would be made for banks in return for loans granted to companies and small enterprises. The CBE's initiative to finance small, medium and micro enterprises is targeting EGP 200 billion in loans at a 5% interest rate and a 7% interest rate to finance the purchase of machinery and equipment for expanding projects in the agricultural and industrial sector and 12% to finance working capital for medium projects in the agricultural, industrial and renewable energy sectors. This will work by:

i. Redefining medium, small and micro companies and establishments by determining the volume of business, annual sales and revenues, as well as the volume of employment.

ii. The CBE stressed the need to develop different departments of banks specialized in financing companies, small and medium enterprises in banks through the development of policies, procedures and internal systems and compilation of the necessary data to establish a classification system appropriate to the nature of this category of birth if this is done within three years from the date of the issuance of the decision.

iii. Giving a two-year deadline to banks to finance companies without obtaining approved financial statements has been allowed to the small and micro companies operating within the informal economy's scope. They usually do not have a tax card and do not make financial statements approved by a chartered accountant. Amendments have been made for female-financed small companies, provided that their sales do not exceed 10 million EGP.

Still, criticism is directed at the initiative because of its launch from the CBE.

Yet the evaluation of the initiative and its results revealed the following:

1. The CBE announced the total portfolio of loans and settlements granted by banks to companies and establishments.
2. The medium, small, and micro-enterprises amounted to 1,442 billion EGP from June 2014 - to January 2016. CBE data indicate that bank financing during the initiative exceeded 115.2 billion EGP. 491,000 clients of medium, small and micro companies benefited from this.

3. The number of beneficiaries reached 55,500 customers, distributed among clients in the corporate and micro-enterprise sector and customers for small projects and establishments.
4. The initiative failed to achieve its goals.

Nevertheless, the CBE initiative was also extended to allow small-scale growers and livestock breeders access to the SME lending initiative. The approval enables commercial banks to receive loan applications from small farms, which are now eligible to receive a subsidized 5% interest rate. Banks must dedicate a portion of their loan portfolios to extending soft loans to SMEs. This differs from the larger-scale industry stimulus initiative the CBE launched in 2020. The separate 100 billion EGP package first targeted factories with annual sales of less than 1 billion EGP. The package was later extended to cover agricultural companies and agricultural production, fish, poultry, and livestock companies. The package enables these companies to access soft loans carrying interest rates between 5-8%.

INSTITUTIONAL ASPECTS

Effective irrigation modernization should account for a proper fit between a functional 'hardware' and a suitable 'institutional framework', intended as a set of formal and informal rules and the organizations governed by such rules.

3. *Ministry of Water Resources and Irrigation (MWRI)*

The Department of Public Works, established in 1836, was the first official institution in charge of irrigation in Egypt. Its name was then changed various times and, since 1999, known as the Ministry of Water Resources and Irrigation (MWRI).

The MWRI oversees water resources research, development and distribution, construction, operation and maintenance (O&M) of the irrigation and drainage networks and the specifications and permits for groundwater well drilling. Together with its regional representatives (Directorates and Districts), they manage the irrigation water distribution into the irrigation network. A further subdivision of roles and responsibilities occurs as the irrigation network approaches the farms, following a four-tiered hierarchical canal classification: main canal, branch canals (BC), tertiary canals (mesqa) and the quaternary canals (Marwa). Mesqas and Marwas are considered private channels, owned and managed by the farmers.

The various irrigation improvement projects in the Nile Delta and Valley are examples of modernization towards shifting from 'rotational' delivery to 'continuous flow'.

4. *Ministry of Agriculture and Land Reclamation (MALR)*

The Ministry of Agriculture and Land Reclamation (MALR), established in 1913, has a vital role at the Mesqa and Marwa levels for the technical assistance and extension in support of the pertinent WUAs. MALR's structure involves several central sectors for agro-economics, agricultural counselling, agricultural services, land reclamation, veterinary affairs, and admin sectors. The MALR mission is to oversee and promote increasing the country's agriculture production. Thus, its mandate includes

planning crops pattern after identifying the country's needs in terms of crops and aiding farmers with selected seeds, machinery, appropriate fertilizers and pesticides.

MALR is also responsible for improving the quality of agricultural lands, expanding agricultural land area, and ensuring equal opportunity pricing of crops and other agriculture products. In addition, disseminating guidance and awareness among farmers on the best agriculture practices is also part of MALR's responsibilities incorporated within a widescale program to develop and improve the socio-economic conditions in rural communities in general.

LEGAL ASPECTS

The relevant laws associated with the framework for agricultural water resource management can be found in the table below.

TABLE 2-1: LAWS ASSOCIATED WITH THE FRAMEWORK FOR AGRICULTURAL WATER RESOURCE MANAGEMENT

Law	Description	Further details
Irrigation law 12 (1984)	Regulates irrigation and drainage "Concerning the Issue of the Law on Irrigation and Drainage". The Law defines public properties related to irrigation and drainage. It also defines the use and maintenance of private canals and field drains and specifies arrangements to recover costs of drainage works. Law 12/1982 is primarily aimed at irrigation as the dominant water user and the MWRI as the water manager that permits all water abstractions.	Section VII of the Law describes the penalties for violations (such as rice cultivation without a permit) and gives the irrigation engineer the right to demand repairs to irrigation or drainage works. The law also addresses the sustainable use of groundwater and how to deal with flash floods and flood plains. The Law does not provide an adequate legal basis for water resources management in an era of scarcity, which demands the involvement of stakeholders in the water sector in the planning and allocation of water resources.
Irrigation law 213 (1994)	Enables user organizations to play a role in managing irrigation water at the levels of mesqa and above in all categories of irrigated land in Egypt. With this, MWRI enables farmer participation in managing improved irrigation systems at the mesqa level and provides the legal basis for WUAs on new lands.	The Law has been adapted to include organizations on old lands as well. However, these organizations can only acquire a legal personality, conform with Law 32/1964 on Private Associations and Unions. The Law enables the recovery of costs if the landowner neglects his duties with respect to the maintenance of the irrigation or drainage system or if he violates the authorization for irrigation of new land.
New irrigation law 147 (2021)	Water Resources and Irrigation Law No. 147 promulgates the Law of Water Resources and Irrigation, repealing Law No. 12 of 1984, which issues the Irrigation and Drainage Law, as well as any provision	Considering water security issues and Egypt's efforts to ensure the conservation of Nile water and groundwaters, the law aims to establish effective water administration, distribution, irrigation, and drainage systems.[1]

[1] https://www.adsero.me/blog/water-resources-and-irrigation-law-no-1472021-165

Law	Description	Further details
	that contradicts the provisions of this law.	
Agricultural law 52 / 1966 its executive regulations	It focused on agriculture-related aspects and was changed in 1983 (Law # 116). Executive regulation's decrees to implement this law were issued by MALR, including decree # 32 / 1967 for animal infectious and communicable disease and decrees # 215 / 1985, # 60 / 1986, 864 / 1996 48 / 1977 for safety, use and disposal of pesticides.	The objective of this law is to regulate agriculture production, production of the plant, animal and fish stocks and the use of pesticides to prevent environmental pollution. It prohibits importing and trading of agricultural seeds, fertilizers and pesticides except under license.

To elaborate on a meaningful prospect towards scaling-up *Irrigation Modernization* in Egypt, it is essential to account for the dynamic and articulated context of the country. The complexity of the Egyptian reality and its social and political economy, along with the implications of intertwining Regional and International developments, is crucial in setting the scene and boundary conditions for properly elaborating a scaling-up process of Irrigation Modernization.

- **Status and Trends of Water Resources Availability and Uses**

MWRI provides the official data on water resources availability and uses in Egypt. Based on the MWRI's National Water Resources Plan (NWRP 2017-203-2037), a summary of the water resources status and trends is reported here.

The 2017 national water resources availability was the baseline for the 2030 and 2037 scenarios. The total freshwater resources available, as per Table 2.2, amounted to 59.6 BCM/ year.

TABLE 2-2 SOURCES OF WATER RESOURCES IN EGYPT FOR THE YEAR 2017

Source	Annual Amount (Billion Cubic Meters – BCM)
Nile River	55.5
Rainfall	1.3
Groundwater	2.45
Desalination	0.35
TOTAL	**59.6**

The water stress index of Falkenmark (1989), based on the number of renewable water resources per capita and per year (Table 2.2), indicates that the country is fast approaching the status of absolute scarcity, driven mostly by population growth. The projection is that Egypt will have 400 m^3 per capita per year in 2037.

For the same year, 2017, the water demand is 61.65 BCM/ year for agriculture, 5.40 BCM/ye for industry and 10.70 BMC/ year for domestic use. The total demand amounts to 80.25 BCM/ year, with evaporation losses, showing an evident gap with 20.65 BCM/ year availability (NWRP 2017). This gap is overcome by the reuses of 'return flow' from the various sectors to the drainage system (with the majority coming from irrigation). In fact, most of the drainage water is used multiple times on its

journey through the country and before being discharged to the sea. This makes the overall efficiency of the Nile system in Egypt very high (around 75%).

Agriculture remains the most prominent water consumer by far. However, with a modest increase in available freshwater resources in 2037 (3.5%), while the trend in the gap between water supply and demand continues to widen, the Egyptian NWRP is targeting a reduction of agricultural water allocation by 3.3% in 2037, as compared to 2017, *vis-à-vis* a corresponding increase of 38.3% of domestic use and 11.1% of industrial use.

The MWRI and the MALR have revisited the cropping patterns to reduce the area extension of selected crop cultivation that are particularly water consumptive, which was the case for rice in 2018, with a reduction of about 357,000 feddan.

- **Major Water Policy Changes**

Water Policy	Description
1800s: Development type policies were started to expand the cultivated area and increase the cropping intensity	Before the High Aswan Dam (HAD) construction, the water policies in Egypt were directed toward developing more water resources, defining "actions affecting the increase of quantities of water available for distribution and use".
1928, 1933 and 1953 policies aimed at increasing the cultivated area	After the construction of the Delta Barrages of Isna, Nag-Hammadi and Assiut
1959: a major shift in water policies	It resulted from the signature of the Nile Water Agreement with Sudan in preparation for the Construction of the HAD to secure 55.5 MCM/year. This agreement laid the ground for the adoption of the horizontal expansion plans. All policies after the construction of the HAD were oriented towards the allocation of water.
National Water Resources Plans 2005-2017	The main goal of safeguarding Egypt's future water resources, both with respect to quantity and quality, and how these resources will be used in the best way from a socio-economic point of view. IWRM considers all interests, such as agriculture, ecology, industrial development, transport, recreation, fisheries and public water supplies.

- **Major Agricultural Policy Changes**

Egypt's agricultural policies developed in a structured and programmatic way starting from the 1960s, after the independence. Initially, the policy focused on balancing the allocation of agricultural fields via a more equitable income distribution and affordable food provision to urban areas. This interventionist institutional structure caused agricultural stagnation, which led to increased food subsidies and land reform on the redistribution of land ownership. From the 1986s and through the 1990s, a reversal of these interventionist policies began with the introduction of liberalizing economic reform policies, giving the private sector a more significant role in the agriculture sector.

Egypt's more current agricultural policies evolved from the 1980s when the initial focus was on formulating institutional and human resources development and addressing water management

issues. In addition, agricultural extension services, research and credit systems were at stake. Subsequent policies fostered complementarity between research and extension services.

Agriculture provides 14.5% of Egypt's GDP[2] while providing 28% of the country's employment[3] and producing 20% of the total exports[4]. In 2015 a total of 61.10 BCM of Egypt's freshwater resources was allocated to 8.70 million feddan. This amount of water has been supplied directly to agriculture or, after its initial use, has been supplied as reused drainage water, either by mixing drainage water with canal water or by direct use from drains. The supplied amount in 2015 is equivalent to an irrigation application of 7,000 cubic meters per feddan (1,660 mm). With this amount, farmers grow between one to three crops per year with an average crop intensity of 1.8 crops per year[5]. Of the water supplied to the crops, an estimated 20% is used to leach the salts from the soil, and 5% is lost due to evaporation from the soil, leaving about 1,100 mm available for crop water consumption. In comparison, maize uses between 500 - 800 mm, cotton between 700 - 1,300 mm per crop cycle[6].

2.2 CURRENT EGYPTIAN PUBLIC-PRIVATE PARTNERSHIP FRAMEWORK FOR THE WATER SECTOR (THE EXPECTED RESULT)7

Egypt has a long history of bureaucracy. The state planning and budgeting system involves two main ministries, the Ministry of Planning (MOP) and the Ministry of Finance (MOF), and the Parliament and other constituents of central and local governments. The economy of Egypt was traditionally a state-controlled economy during the sixties and seventies. The main economic sectors were identified as the Governmental sector, Public sector and Private sector, where the government and public sectors have dominated the private sector in most economic activities. A major shift was made in the 80s and thereafter towards a free economy system. This strengthened the private sector but did not eradicate all forms of government controls. Egypt operates under the same three economic sectors, including the state-owned biggest banking systems.

The economic and social development plan in Egypt is the general plan for the state's investment projects within a specified period (usually five years) to ensure the improvement of living standards and the quality of life of Egyptians. Essentially, this is not limited to economic aspects only but also includes other social, cultural and political aspects, including social subsidy, health, education, energy, sanitation, housing, transportation, "water", and other infrastructure and public service projects.

The state's general budget is the financial program for the next fiscal year. It includes all uses and resources of government agencies (central administrative authorities, local governor's

[2] IMF Country Report No. 15/33, 2015.

[3] 2013 statistics compiled by the World Bank, found at: http://data.worldbank.org/indicator/SL.AGR.EMPL.ZS?locations=EG

[4] Statement by H.E. the Minister of Agriculture, Cairo, September 2010

[5] Cropping intensity as calculated by the Agricultural Sector Model for Egypt (ASME), using the 2015 water balance data

[6] These are indicative values, which are sensitive to crop duration and climate conditions. They are given here only to provide a feel for the extend of water availability. Source: FAO, **Irrigation Water Management**, Training manual no. 3, Rome, 1986

[7] Page # 28 of the report

administration, and other service agencies). Spending within the general budget consists of several categories, including local and international loan payments as well as the "government investment plan" in government agencies, which represents Chapter Six of the state budget. It defines investment projects and budgets assigned to it.

Project funding sources

Determining the monetary resources needed for a project under the plan and budget, whether for its capital or current uses during a specific period, imply careful consideration of the following factors:

- Financing needs based on expected uses.
- The different sources available to cover these needs.
- Foreseeable risks from the utilization of these resources.
- The proposed management schemes.

The provision of the necessary funding to the various parties within the framework of the state's general budget is the availability of resources. In case of insufficient funding to meet the authorities' needs, projects are arranged according to standards and different comparisons to identify projects that go along with the amount of funding available. The projects are usually financed via internal or external sources.

Internal sources	The funding available from within the entity is expressed as self-financing. The entities that engage in economic activity, such as economic bodies, have self-resources from retained earnings or in exchange for the established allocations and reserves.
External sources	The sources from outside the entity or unit, and by them, we mean what was made available with loans from the National Investment Bank, which the public treasury has now replaced, in addition to foreign grants and loans.

Egyptian Public-Private partnership Framework for Water Sector and how it facilitates (Irrigation Procurement and Investment)

Public Procurement Law

On October 3, 2018, a new Egyptian public procurement law, namely, law no. 182 of 2018 was issued to regulate contracts concluded by public authorities. The executive regulation of the law was published on October 31, 2019. More information regarding the law can be found here. [8]

Egyptian PPP Framework

It should be noted that in the Egyptian context, the Public-private partnership (PPP), which started in the early 2000s, is only used for the private sector participation in establishing large utility projects, such as power stations, sanitation projects, drinking water stations, that are worth at least 100 million EGP ($ 7 million US) each.

Thus, for this current report, PPP projects do not fully describe the desired framework of cooperation and participation of farmers to implement modern means of irrigation in their lands but can be better categorized as a scheme of soft loans and credit to assist farmers in complying with the state policy in this regard.

[8] Egypt: The new Public Contracts Law No. 182 of 2018
https://www.lexology.com/library/detail.aspx?g=8063140a-bdba-47c0-b8b8-e517fdadc69c

According to the FAO Roundtable on Financing Agricultural Water (2021), PPP is complex within the Arab region but needed. The current PPP model in Egypt is based on Concessions (see Table below). In this form of PPP, the Government defines and grants specific rights to an entity (usually a private company) to build and operate a facility for a fixed period. The Government may retain the ultimate ownership of the facility and/or the right to supply the services.

This Project is funded by the European Union

TABLE 2-3: PPP OVERVIEW WITHIN THE ARAB REGION. SOURCE: FINANCING AGRICULTURAL WATER FROM FAO (2021)

Country	Scheme	Size [hectares]	PPP model	Farming activity	Project costs	Economic details	Other details
Morocco	Guerdane	10,000	Design Build Operate	Cash crops	$85 m for infrastructure	Gross irrigation Productivity: $1.0–$2.0/m³ (for 8,000 m3/ha) Water pricing: $0.15–$0.20/m³	
Mauritania	Nakhlet	27	Operation and management	Rice	NA	Gross irrigation productivity $0.030/m³ Irrigation water value $0.015/m³ Price of the water service $0.002/m³	Village scheme/cooperative with 29 farmers Finances the cropping season with its working capital.
Jordan	Adasiyeh	400	Operation and management	Citrus	NA	Gross irrigation productivity $2.72/m³ Irrigation water value $2.49/m³ (citrus) Price of the water service $0.021/m³	A successful experiment, whereby quotas were enforced and well respected as an alternative to the incumbent rotation of water distribution for water management.
Saudi Arabia	Business farms	2,000,000	NA	Wheat, alfafa		NA	Government offered free land as part of a vast program of highly subsidized irrigated agriculture in 1980, including free groundwater, free credit, and a guaranteed purchase price of $1,000/ton of wheat. Program covered eight highly capitalistic business farmers; medium-sized farms, and traditional Bedu farms.
Egypt	Dina Farm	4,400	Concession	wheat, berseem clover, alfalfa, corn, banana, tomato, potato, other vegetables		Gross irrigation productivity $0.32/m³ (banana)	Though an entirely private investment, the government of Egypt, provides a partly free groundwater supply at an estimated average of 20,000 m3/ha/ year

This Project is funded by the European Union

In general, Egypt issued the PPP law 67 in 2010 to regulate public-private partnership projects, giving administrative authorities the power to conclude partnership contracts.

Examples of partnership projects with the private sector in the Egyptian experience

The private sector has participated in many infrastructure projects with the public sector in various sectors such as water and sanitation, electricity, energy sources, roads, airports, ports and tunnels, education, hospitals and others. The electricity sector and various energy sources are among the most important industries that adopt public-private partnership projects in Egypt, as most electricity and energy plants were implemented through partnership due to their feasibility. PPP is not applicable in the case of implementing a wide-scale modern irrigation program because of reasons regarding nature and magnitude.

2.3 EFFECTIVENESS OF APPLIED METHODS (ON-FARM)

OVERVIEW OF THE TRANSACTIONAL MODALITIES AND INSTRUMENTS RELATED TO INVESTMENTS IN ON-FARM IRRIGATION INFRASTRUCTURE AND MODERNIZATION

To give an overview of investment patterns, modalities and instruments created to facilitate on-farm irrigation implementation, it is necessary to understand the overall agricultural investment history throughout the previous decade.

Overall investments in the agricultural sector

The table below shows the total value of agricultural investments in Egypt, which amounted to 17,338 million EGP in 2016/2017, equating to 3.37% of total investments in Egypt. This was distributed into i) government investment 6,038 million EGP (34.8%) and ii) private investment 11,300 million EGP (65.2%).

This table highlights that agricultural investments constitute only a small percentage of the overall national investments (less than 5%) at the time. Furthermore, the private sector/ individual investment represents most of the agricultural investments.

The table only accounts for investments until 2016/2017. It should be considered that the amount of government investment in the agriculture sector has since increased by large amounts as the canal rehabilitation project started in 2020 with a total investment of 80 billion EGP in two years. Also, the signed protocol between MWRI, MALR, MOF, NBE, ABE to fund the transformation to modern irrigation in old lands includes a total investment of 60 billion EGP.

TABLE 2-4 AGRICULTURAL INVESTMENT (IN MILLION EGP)

Years	Government Investment	Private Investment	Total Investment	Agr. INV % Total INV	Gov. INV % agr. INV	Private INV % agr. INV
2012/2013	2,950.4	5,434.0	8,384.4	3.47%	35.2%	64.8%
2013/2014	4,146.1	7,480.5	11,626.6	4.39%	35.7%	64.3%

2014/2015	5,213.0	8,201.0	13,414.0	4.02%	38.9%	61.1%
2015/2016	5,039.2	11,240.0	16,279.2	4.15%	31.0%	69.0%
2016/2017	6,038.6	11,300.0	17,338.6	3.37%	34.8%	65.2%

Agricultural financing modalities

- ***Farmers' sources of finance***

Traditionally, most small farmers rely on their own resources to finance their operations. These resources include the support of relatives, friends, and traders who provide farmers with supplies and then collect the repayment once the crops are harvested and sold. The figure below describes the source of financing for agricultural projects.

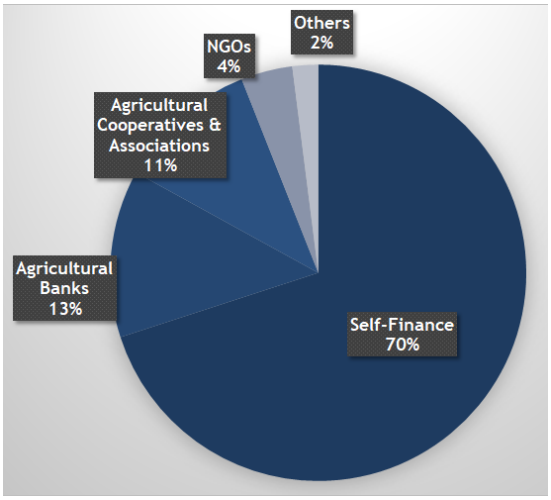

FIGURE 2-1 SOURCE OF FINANCING AND % USED BY FARMERS

- ***Banking Community Contribution, Initiatives to Finance Agricultural and Water Resources Projects***

Nonetheless, some farmers do resort to formal financial services. These include banks, of which the Agricultural Bank constitutes the bulk of services, leaving a small percentage to commercial banks.

The average value of credit granted to the agricultural sector by the banking system at current prices amounts to about 22 billion EGP, representing approximately 4.5% of the average total value of bank credit, which amounted to about 505 billion EGP during the period (2001/2000 - 2016/2017). Where commercial banks provided nearly 7 billion EGP on average, representing about 32% of the average total value of bank credit, and the ABE (the Main Bank for Development and Agricultural Credit) provided about 15 billion EGP, representing about 68% of the average total value of credit granted to the agricultural sector from the banking system.

By analyzing the demand and supply of agricultural credit, the results of standard models showed that the most important factors affecting the volume of demand for credit for agricultural loans are the demand for investment loans, the interest rate, total agricultural wages, the value of the agricultural investment, reclaimed area, total agricultural income, total demand for agricultural loans in the previous year. As a result, the rate of investment in the agricultural sector decreased compared to other economic sectors.

The ABE has contributed a large percentage to the credit granted to the agricultural sector during that period, despite the bank's dealings in accordance with market rules and the expectation of competition from other non-agricultural banks in providing credit to the agricultural sector, as well as after allowing the private sector to trade in all the requirements of production.

TABLE 2-5 PERCENT OF AGRICULTURAL LOANS FROM COMMERCIAL BANKS IN EGYPT

Year	Commercial Banks (EGP)	Agricultural Development Bank (EGP)	Total Agricultural Credit (EGP)	Total Credit in Egypt (EGP)	% of Agriculture to Total Credit
2011	9114	15259	24373	474139	5.1%
2012	6220	14796	21016	506736	4.1%
2013	6219	14223	20442	549120	3.7%
2014	6814	16065	22879	587852	3.9%
2015	8438	18533	26971	942727	3.8%
2016	10462	17633	28095	942727	3.0%
2017	11011	15369	26380	1426457	1.8%

From the table above, it is evident that the value of agricultural loans provided by commercial banks to the agricultural sector at current prices increased from about 5.3 billion EGP during 2000/2001, with a rate of approximately 31.4% of the total bank credit. The agricultural sector amounted to about 16.9 billion EGP for the same year, to about EGP 11 billion during 2016/2017, a rate of about 41.7% of the total bank credit to the agricultural sector, which amounted to about 26.4 billion EGP for the same year.

The ABE plays a prominent role in financing agricultural activities compared to other sources; 68% of the total volume of bank credit is provided to the agricultural sector, followed by commercial banks at a rate of about 32%. These banks provide loans for agricultural activities due to their multiple economic and natural risks. This confirms the importance of a specialized agricultural bank and is considered inevitable and necessary.

- ***Obstacles associated with credit mechanisms from banks***

This is a complicated application procedure. The governing rules include that the customer must bring several documents when applying for an agricultural loan.

This procedure was initiated from the banks' perception of high risks associated with *economic*, technical, marketing, distribution and pricing inefficiencies.

The farmer's perspective, who have taken loans from the ABE, stated that they faced problems in loan repayment. According to a 2018 study of farmers[9], the nature and incidence of these problems are as follows:

- 59% cited high-interest rates
- 19% cited liquidity problems
- 19% cited revenues that were lower than expected.

9 HLB-MC Survey Results, 2018

- 3% cited other causes such as procedures, lack or short grace period, short repayment period and penalties.

- ***Investments in on-farm irrigation infrastructure and modernization:***

On-farm modern irrigation is a relatively new practice in Egypt. Traditionally Egyptian farmers used flood irrigation to irrigate their lands. In addition, farmers initiated individual trails whenever they faced water scarcity problems, but these initiatives were scattered in the newly cultivated lands.

Investments in Irrigation modernization at the farm level are expected to offer significant opportunities for improving the productivity and competitiveness of the agricultural sector. Switching to modern irrigation will increase agricultural productivity by up to 30% - 50% and improve the quality of the agricultural product, i.e. enhancing the quality of irrigation water, reducing the irrigation costs and thus, increasing the yield from agriculture, and reducing the dependence on the use of agricultural drainage water, which contributes to improving the quality of water used in irrigation.

The two main methods for modern irrigation endorsed by the MWRI are **sprinkler** and **drip irrigation**. Factors affecting the decision are directly related to soil salinity problems associated with these two types of irrigation. Pilot implementation experiences have been applied on the ground, where several farmers in certain governing bodies have converted the irrigation method from surface flooding irrigation to drip irrigation. This contributed to increasing crop productivity, increasing the percentage of water savings used for agriculture, increasing the percentage of fertilizer savings, and reducing energy costs.

Replacing flood irrigation with modern irrigation systems in the valley and the delta will also rationalize water use in irrigated agriculture, raise the water unit's value, and meet the needs of drinking water and the various development sectors.

Farmers will be given full responsibility for financing and implementing the on-farm modernization, while the government will facilitate them with soft loans and credits. The MWRI will maintain a regulatory and supervisory role. The MWRI has submitted a proposal to fund the project through the national banks while encouraging farmers to switch to modern irrigation systems. It is suggested that the project be implemented by providing loans with simple interest to farmers, and the payment should be made in annual instalments over five years.

On-farm modernization is merely a private investment. Farmers are keen to invest in water-saving technologies only if water shortages prevail and modern technologies are cost-effective and affordable. As most farmers in old-lands produce traditional and low-profit margins, modern on-farm technologies must generate substantial additional net benefits, which remains questionable. Land levelling and the improvement of soils are costly and entirely reliant on specialized service providers. Furthermore, the mechanization rate of farmers is low (averaging 13-27%). However, the cost of these services (450 - 600 EGP per feddan), which can reach up to 15-20 % of the production costs, is concerning because many active farmers currently do not own their land. They work on leases for several years.

Like anywhere in the world, small farmers in Egypt are risk-averse in their decision-making. FAO field evidence shows that smallholder farmers are not yet prepared to invest in technology they do not fully understand. At the same time, current financing and cost recovery modalities for the National

Irrigation Modernization are subject to uncertainty and significant risks for private farmers and their WUAs.

As the principal owner and caretaker of public infrastructure, the State needs to ensure that the private investment secures the level of tenure and service security required to make investments sustainable. The program will likely not meet its ambitious targets without a comprehensive financing structure and plan.

Conversion to modern low-pressure systems requires simultaneous investment by the WUAS and farmers. Most mesqa infrastructure is old and in a poor state, so the investment is significant and urgent. However, the WUAs will have little or nothing to offer loan collateral since they are granted the right to use infrastructure and do not own it.

ABE offers agricultural loans to farmers at 5-10 % interest and over relative short repayment periods, which are not well coordinated with the ability of farmers to repay. The current engagement with the ABE is a workable arrangement. However, the subsidized interest-based loans need further elaboration and refinement in terms of lending instruments, eligibility, and sustainability conditionality.

Besides, the government should consider a much more substantial involvement of the private sector Financing through agribusiness. For example, the recent partnership between the International Finance Corporation (IFC), the World Bank subsidiary responsible for private sector financing, and ABE. The collaboration aims to finance solar-powered irrigation systems in Egypt. This partnership may well serve as a model for similar arrangements. Other opportunities for private sector involvement exist in adopting out-grower models, by which agribusiness can invest in smallholder systems to source their raw products from them.

The NWRP outlined targeted areas of agricultural lands to implement modern irrigation as well as the related investments required by the public and private sectors through the year 2037, as follows:

TABLE 2-6: TARGETS AND ESTIMATED COSTS OF IRRIGATION MODERNIZATION PROJECTS AS INDICATED IN THE NWRP (2017-2030-2037)

Project	Target to year 2037 (feddan)	Unit cost (EGP per feddan)	Total estimated cost (Billion EGP)	Comments
Mesqa improvement	825 000	30 000	24.75	To be implemented by MWRI
Modernization of Irrigation	485 000	25 000	12.13	To be implemented by MWRI
Improvement of on farm irrigation	970 000	15 000	14.55	To be implemented BY MALR

- ***Public sector financing challenges***

O&M financing of the entire canal system is unclear: The annual budget of the MWRI of $ 0.6 billion (EGP 3.7 billion) translates to an average cost of $ 0.01/m^3, considering gross water allocation to Egypt of 55.5 billion cubic meters.

Some of the WUAs charge for mesqa level and for branch canal (partially level operation and maintenance through irrigation fee that may vary between 40 - 170 EGP per feddan per irrigation turn, but it is not applied consistently by all the WUAs. Egyptian farmers do not pay for water used on their farms and only bear the on-farm irrigation costs. The farmer pays an average of $ 2.6/

feddan/ year as a land tax, which is expected to recover infrastructure costs by installing drainages and improving mesqas. Thus, the GOE implicitly subsidises the entire expenses related to the system's O&M, so costs are unclear.

Public infrastructure investment is underfunded. The investment cost of the ongoing Branch Canal Rehabilitation Program is estimated at EGP 1.3 billion (US$ 82 million), which is likely to be insufficient to reach the level of water control in-branch canals and service delivery that are required for continuous supplies to tertiary mesqa levels.

Additional investment is likely required to upgrade the Nile water system to improve the flow and level control for improved and continuous delivery into the main and branch canals. Still, these costs have not been estimated yet. A country investment profile prepared by the FAO in 2015 identified investments totalling $ 2.168 billion for the rehabilitation and improvement of irrigation and drainage systems in 5 regions, including the modernization of pumping stations.

- ***Systemic challenges to financing irrigation modernization***

Successful transition to modern systems requires proper knowledge of localized irrigation practices and O&M. Most farmers are entirely inexperienced in using modern systems. Modern irrigation systems are accompanied by land levelling, soil improvement and are dependent upon specialized service providers.

Irrigation water is provided to farmers free of charge. However, farmers along previously improved canals are expected to cover the cost of collective pumping arranged through the mesqa WUAs. In these New Lands, the government provides the water to farmers for free. However, farmers must still cover the costs of diesel pumps, including borehole setting and installation costs of pumps. Therefore, the cost of pumped irrigation water is indirectly subsidized via fuel subsidies in Egypt.

The cost of these services (450 - 500 EGP per feddan) can reach up to 15-20 % of the production costs. Therefore, the ability of the modern irrigation systems to produce additional net benefits, particularly in old lands, where the farmers produce traditional and low-margin crops, is questionable. Furthermore, many active farmers work on leased land and have a short investment horizon that is not compatible with investing in such systems.

- ***Lending modalities in terms of various initiatives by the GOE and MWRI and MALR:***

On March 13, 2019, Resolution No. 504 was issued by the CBE regarding the inclusion of cooperative societies established by farmers. Also, within the framework of the Central Bank's initiative for small companies and enterprises, the decision stipulated: "Allowing banks to finance cooperative societies - whether those of farmers or associations established for the purpose of switching to modern irrigation methods - was made possible within this initiative for small companies and enterprises at a return rate of 5% (simple diminishing return).

In addition, a range of key initiatives has been taken by the Government to facilitate financing options within the agricultural sector. These initiatives include the following:

TABLE 2-7 KEY INITIATIVES TO FACILITATE FINANCING OPTIONS WITHIN THE AGRICULTURAL SECTOR

Initiatives	Description	Considerations
1. SME initiative (launched in 2015)	The CBE includes small farmers in an SME initiative, which allowed commercial banks	The analysis presented in Table 2.7 suggests that only farms exceeding

Initiatives	Description	Considerations
	in March 2019 to grant subsidized loans with 5% interest rates to small farmers who adopted modernized farming techniques (Enterprise,2020)[10]. According to the NBE, the farmers could apply for this loan if their Annual sales range from 250,000 EGP to less than 50 million EGP (NBE,2019)[11].	some 7 feddan in the area qualify for the initiative. This limit is implemented to avoid the transaction costs associated with providing loans to multiple smaller operations.
2. Loans for the agriculture sector	The CBE issued assurances worth 100 billion EGP for banks to give loans with an 8% decreasing interest rate in May 2020 through the manufacturing, agriculture and contracting support initiatives.	
3. Funding for farmland owners	A cooperation protocol between the MWRI and NBE provides funding for farmland owners to transition from traditional irrigation systems (flood irrigation) to modern systems (sprinkle drops, drip irrigation canal lining, etc.) or new farmlands that require installing a modern irrigation network.	
4. Small farmers loans	In 2019: The ABE provided small farmers loans by 7%. 20% of the loans in the portfolio are granted for agriculture mechanisation projects, and 30% of the loans are given to the small farmers for crop production.	
5. Yearly financing of the agricultural sector	Agricultural Development Program (ADP) **finances the agricultural sector,** which provides 7.5%-9.5% per annum, through several different programs.	However, the minimum ticket is usually above 100,000 EGP and is subject to credit analysis from the bank (in this case, CIB).
1) **Low-interest loans to enhance the agriculture sector**	The International Fund for Agriculture Development (IFAD) **provides these low-interest loans** to the settlement of land reclaimed from the desert in Lower (Northern) Egypt and for productivity	

10 https://enterprise.press/stories/2020/06/17/central-bank-of-egypt-approves-soft-loans-to-small-farms-under-sme-initiative-17180/

11 https://www.nbe.com.eg/NBE/E/#/EN/ProductCategory?inParams=%7B%22CategoryID%22%3A%22cbe5agri%22%7D

Initiatives	Description	Considerations
	improvements in the old lands in the Nile valley and Upper Egypt.	
6. **Modernization Financing for farm Level Irrigation**	There are serious initiatives from the government to **provide incentives to finance the agricultural sector,** and there is a political will to move from traditional irrigation processes to modernized irrigation systems, e.g. the MWRI is granting 5,000 EGP for farmers to install modernized irrigation, with technical support, to be repaid interest-free over 1-2 years period,	This is a finite project implemented as a pilot one.
7. Monetary policy to control inflation	From a broader perspective, the CBE is adopting a **monetary policy** to reduce the country's average interest rate, which could directly impact the reduction of average borrowing rates in commercial banks in Egypt. The CBE initiative currently provides an average borrowing interest rate ranging from 5-7%, while the average retail borrowing rates range from 10-13%.	The gap is expected to close further, as further reductions are anticipated allowing borrowing rates to approach 8-9% within 1-2 years.
8. Micro loans	Development programs of various sorts provide micro loans. These programs are usually time-bound and have specific target beneficiaries. Although they are characterized by relatively shorter processing times, the interest rates tend to be higher, ranging from 13-18%.	Modernization loans of 10,000 EGP are not attractive to commercial banks vs, e.g. the CBE initiative (see 1).
9. Avoiding high transaction costs	• Issuing loans to groups of farmers, such as WUAs or sub-sets thereof, reduces transaction costs and introduces the possibility of **social collateral**, whereby default, one member compromises the credit rating of the entire group. • Another way to reduce the transaction costs to the FSP is to **transfer** the transaction **costs to the point of sale**, whereby the equipment retailers become brokers of the commercial financing.	
10. **Loans without interest**	During August 2021, MWRI, MOLR, MOF, NBE and Agricultural Credit Bank signed a new protocol to the value of 60 billion EGP	There will be no interest associated with these loans for 10 years. The term of operation is four years

Initiatives	Description	Considerations
	(4 billion US $), of which two thirds will be utilized to rehabilitate *mesqa,* and one third will be used to implement means of modern irrigation in old land as well as the remaining of new lands.	starting from the date of signing and is renewed for other periods unless one party desire to terminate it. In the event of non-renewal, the parties' obligations remain in effect until loans granted are fully repaid.

Under the protocol mentioned in Table 2-5, no. 11, it will help provide funding for the costs of rehabilitation of agricultural water mesqas, financing for the costs of switching to the use of modern irrigation networks, and providing technical support through specialists in the MWRI, MALR to rehabilitate mesqa and shift from flood irrigation to modern irrigation.

The beneficiaries of this protocol are the owners of the old agricultural lands located in the valley and delta in the targeted areas.

MWRI agreed to set specifications for the rehabilitation of canals and means of modern irrigation, to define and quantify agricultural lands within the targeted area of lands for irrigation modernization, to apply positive and negative incentives to farmers and to start implementation in the governorates of Qalyubia and Beni Suef as two pilot areas.

SUMMARY OF THE SMALLHOLDER FARMERS' LANDSCAPE AND RELEVANT COOPERATION MODALITIES.

Regarding the status of agricultural land ownership fragmentation, small lands are predominant in almost every part of Egypt. Land consolidation can improve this situation, but no legal measures have been established. As a result, smallholder farmers don't own much land, disqualifying them from becoming members of the various co-operatives. Although the WUAs are directly related to the MWRI, their legal status, organizational structures, and financial capabilities are still questionable. They don't have the power to entirely focus on the farmers' needs. On the other hand, agricultural cooperatives are much more established and have provided support to farmers for a long time. Despite various related problems, they constitute a much better choice to implement a wide-scale program for modern irrigation.

The differentiation between old lands and new lands affects implementing modern irrigation systems.

- ***Agricultural land ownership***

The land holdings in Egypt are significantly fragmented, with an average farm size of less than 2.5 feddans. The small-holders produce around 47% of field crops, 61% of large ruminants, 60% of small ruminants and a variable proportion of horticultural crops. Due to their size, small farms are often not eligible to benefit from public support, bank loans and public support, which have left them small, technologically backward, and poor. They have less developed production technologies and marketing systems than large-scale farming and a high rate of illiteracy. In addition, the farming system is labour intensive and not attractive to the younger generation. The trend of holdings and farm size over the last 50 years is reported in the Table below.

TABLE 2-8 NUMBER OF HOLDINGS AND FARM AREA DISTRIBUTION (%) OVER THE PAST 50 YEARS IN EGYPT

Area (feddan)	1961		1981		2011		2016	
	Holdings (%)	Farm area (%)	Holdings (%)	Farm area (%)	Holdings (%)	Farm area (%)	Holdings (%)	Farm area (%)
≤ 0.42	26.4	3.4	32.3	6.5	34.6	6.2	41.4	9.3
0.42–1.26	40.9	18.5	44.5	28.7	45	33.6	40.3	30.6
1.26–2.1	16.7	15.9	13.3	17.8	12.1	9.8	8.3	8.6
2.1–4.2	10.3	17.7	7.5	16.6	6.8	17.4	8.6	16.2
≥ 4.2	5.7	44.5	2.4	30.4	1.6	33	1.4	35.3

This trend indicates the slight decline in the number of holdings of large farm size (in the range of 1.26 - 4.2 or more feddan) and the slight increase in the number of holdings of small farm size (in the range of 1.26-0.42 or less feddan). An almost mirror image is for the change in farm size. Overall, these data clearly show that no improvement has occurred so far in terms of land-ownership consolidation, and this characteristic is not conducive to a quantum leap in agricultural land and water productivity. An acceleration of the various reforms of land consolidation and grower associations (cooperatives) is necessary to take full advantage of other modernization processes, such as the one prospected for irrigation.

- ***Land reclamation:***

By 2018, Egypt's total cultivated area had reached a total of 9.3 million feddan. Of this total, the old lands constitute 6 million feddan. In comparison, the new lands amounted to 3.3 million feddan and continue to expand – at a rate of 3.6% from 2011 to 2017, as compared to a rate of only 0.6% for the old lands during the same period as shown in Table below, which also indicates the areas for seasonal versus permanent crops.

TABLE 2-9 CULTIVATED AREAS IN EGYPT BY LAND TYPE AND CROP TYPE (FEDDAN)12

YEAR	OLD LANDS	NEW LAND	SEASONAL	PERMANENT	TOTAL
2011	6,071,219	2,548,208	6,686,243	1,933,184	8,619,427
2012	6,019,395	2,780,044	6,735,607	2,063,832	8,799,439
2013	6,182,507	2,771,816	6,805,606	2,148,717	8,954,323
2014	6,082,176	2,834,289	6,727,238	2,189,227	8,916,465
2015	6,155,756	2,939,949	6,895,131	2,200,574	9,095,705

[12] CAPMAS Statistical Yearbook, 2019 – Agriculture Section

2016	6,147,646	2,953,558	6,910,566	2,190,638	9,101,204
2017	5,985,056	3,148,203	6,930,845	2,202,423	9,133,259
Average Annual Rate	**0.3%**	**3.6%**	**0.8%**	**3.3%**	**1.4%**

- ***Land fragmentation in Egypt***

There are two types of land ownership fragmentation, internal fragmentation (within a farm); and separation of ownership and use. The main problems associated with land fragmentation are vague boundary lines, the small size of plots; lack of direct access; and irregular shape of plots. This results in a complicated boundary network, wastage of non-cultivated areas; increasing conflicts between neighbouring landowners; and constraints on harmonized development and efficient design.

Most small-scale farmers (SSFS) continue to use the traditional flood irrigation system. The last census of 2010 shows that about 94.8 % of SSFs and 80 % of medium and large farm holdings depend on the Nile water for irrigation. Nearly 5 % of the SSEs rely on other irrigation sources such as underground water and freshwater blended with reused agricultural drainage water. Yet, a small percentage of SSFs applies modern on-farm irrigation systems, particularly sprinkler or drip irrigation.

The prevailing legal forms of land tenure in Egypt are owned land, cash rented, and share rented. The share ownership of small-scale farmers reached 92 % of the total household number in 2010, accompanied by a share of the land area owned reached 90.1 % of the total land area. Regulatory frameworks' absence or weakness would enable them to claim their rights, defend their interests, and participate in economic, social, and political policies. Therefore, owned holdings of small-scale farmers become the prevailing legal form of land tenure.

Excessive fragmentation or uneconomically smallholdings may prevent the farmer from using his time and resources to best advantage or adopting modern means of production, e.g. mechanization. Also, fragmentation could lead to sub-optimal usage of factor inputs and thus to lower overall returns to land. The factors contributing to this could be losses due to extra travel time, wasted space along borders, inadequate monitoring, and the inability to use certain types of machinery such as harvesters or modern means of irrigation.

The fragmented nature of land plays a significant role in explaining low levels of agricultural productivity. Further, there is evidence of inefficient use of resources in agriculture and the resulting costs increase.

- ***Land Consolidation in Egypt***

Land consolidation is a highly effective land management instrument that allows for the improvement of the structure of agricultural holdings and farms, which increases their economic and social efficiency and benefits both right holders and society in general.

There are different forms of land consolidation in rural areas, including regulated voluntary, majority-based and mandate of land consolidation, facilitated by land professionals and mandatory land consolidation.

Several principles for land consolidation serve as the core structure for all respective regulations, starting with the Land Consolidation Law and ending with the lowest level implementing secondary

legal acts. Areas where land consolidation projects are already being implemented increase the involvement of the landowners/ users in land consolidation projects in their own area.

Despite land fragmentation spread in Egypt and its impact on the growth of the agriculture sector, land consolidation has not been practised. Water management has its share of problems with land fragmentation in terms of water allocation, irrigation and drainage. The combination of land fragmentation and uncontrolled crop pattern is considered the twin factors impeding improvements in the agriculture sector and improvement of water management.

The natural way to overcome this problem is by forming farmers groups of common interest to share resources and get the advantages of liaison and cooperation.

- ***Forms of organizing farmers groups***

There are two forms of farmers associations initiated by MWRI and MALR on different stages.

Agricultural cooperatives with the MALR

Agricultural cooperatives were found to be one of the oldest and most important cooperation sectors in Egypt. It was also found that agricultural cooperatives played an essential role in developing the agricultural sector and provided support and services to farmers since the 1960s, within the framework of state policies and agrarian reform. There are currently 5,435 agricultural cooperatives on the local level, i.e., at the level of villages, subdivisions known as “marakez”, governorates and some general cooperatives at the national level.

Despite their important role, obstacles are hindering the development and activation of the role of agricultural cooperatives, which limit the effectiveness of the implementation of the 2014 Act.

Water Users Associations with the MWRI

The MWRI is responsible for water management, operations, and maintenance until the branch canal level. In contrast, the water distribution, operations, and management at the tertiary and quaternary levels are under the responsibilities of the farmers. In fact, *mesqas* and *marwas* are considered private channels, owned and managed by the farmers. Main canals run continuously, while the distribution at the branch level is presently done dominantly on a rotational basis. The various irrigation improvement projects in the Nile Delta and Valley are an example of modernization towards the shift from ‘rotational’ delivery to ‘continuous flow’.

An important part of the irrigation system is the drainage network, consisting of a web of laterals and collector drains. It collects the local run-off and surplus water after irrigation and conveys it to the open drainage canals. The drainage network covering the entire Nile Delta, is primarily used to control the water table and salinity of the soil. The reuse of drainage water is common in the delta region, and the tail-enders use both drainage water and fresh canal water for irrigating their crops. Drainage water is also mixed with fresh water at secondary and primary canal levels through pumping stations established by the ministry.

Against the more solid institutional asset and governance of the MWRI, the farmers needed to be organized into proper Water Users Associations (WUA) to manage irrigation at *mesqas* level and into *marwas* committees (MCs) for the management of the quaternary canals.

The decentralized governance of some operation and management responsibilities through Water Users Associations (WUAs) is one of the key reforms introduced in irrigation modernization. The

participation of farmers in the various decision-making processes is a crucial element of the institutional upgrade.

WUAs may play important roles in innovative ways of organizing WUA at the Branch Canal level (BCWUA), allowing broader participation of farmers. In 1999, a decree demanded the establishment within the MWRI of the Central Department of Irrigation Advisory Services (CD-IAS) as a permanent unit to serve all sectors of the MWRI and BCWUAs, WUAs, and MCs oversee O&M of Branch Canal, *mesqa* and *marwa*, respectively, while the MWRI manage the irrigation water distribution into the irrigation network from the High Aswan Dam until Branch Canal level.

Most WUAS / Agricultural Cooperatives (ACs) in Egypt have no accumulated capital unless members agree to contribute. Also, candidates and the ABE should be encouraged to do due diligence on WUAs in Egypt. Due to their instituted collective interest in the operation, management, and maintenance of mesqa, they could be intermediaries for farm irrigation modernization, i.e. facilitating the channelling of funds between lenders and borrowers indirectly.

Modernization

Modernizing on-farm irrigation management requires a flexible, equitable, and reliable water delivery service to fields. Typically, the schemes use a variety of pressurized on-farm irrigation technology ranging from drip irrigation to fully operational center pivot sprinkler machines. The program adopts drip and sprinkler systems as a means for on-farm irrigation modernization. Modern irrigation methods will be selected and used according to the soil salinity levels. Salinity issues can be quite different when the same field crop is irrigated with varying irrigation methods (sprinkler versus drip).

Sprinkler irrigation systems	Field/row crops are typically designed to apply water evenly across the soil/plant surfaces. Therefore, water infiltrates the soil and moves throughout the ground vertically.
Drip irrigation	Applies water at localized points. Therefore, water infiltrates the soil and moves both laterally and vertically. Thus, with drip irrigation, it is often possible to maintain a higher root zone salinity level than with sprinklers, resulting in less salinity damage with drip given the same soil salinity level.

On New Lands, most farms already use modern irrigation systems to irrigate orchards and other perennial crops, but mainly from groundwater, which has raised sustainability concerns. Therefore, the most challenging change that needs to occur is improving the water governance and the institutional arrangements of the irrigation and drainage service delivery system.

Another concern is the innovation of public and private investment financing structures. Both the banking and non-banking solutions are proposed. Specialized ministerial orders adequately regulate it. It would provide sufficient finance at affordable investment conditions, which conforms with technically and economically sound farm investments, certified by independent engineers.

2.4 DIFFERENCES AND BEST PRACTICES OF APPLIED METHODS

Irrigation modernization in Egypt has been a long journey. The most significant turning point was the High Aswan Dam construction between 1959 and 1967. Recently the GOE launched a new program aiming to increase irrigation efficiency, rationalize water use at the farm level and increase

agricultural productivity. The program is envisaged to cover nearly all irrigated lands, old and new, with modern irrigation systems.

Egypt's irrigation modernization program is highly ambitious with unprecedented scope and challenges. It intends to convert the sum of 9 million feddan from traditional to modern pressurized irrigation - almost all irrigated land in Egypt. Through this program, the government is determined to boost the agricultural output from irrigated agriculture by up to 30 % while reducing water allocation to agriculture by 10 % till 2030 and 15 % by 2037, respectively. Considering Egypt's looming water scarcity situation, this vision is achievable only if the irrigation modernization program succeeds in making the desired farm investments into drip and sprinkler systems at a large scale - especially on Old Lands in the Nile delta with its highly fertile soils.

The modern irrigation transformation project, implemented by MWRI and MALR, aims to convert from flood irrigation systems to modern irrigation systems in the old lands of the valley and the delta through a rapid mechanism in a period not exceeding ten years (by involving farmers in implementation, management and maintenance, which will lead to raising the efficiency of water use on the field level and reduce transmission losses in the mesas and irrigation systems).

The program is based on the expansion of modern irrigation systems in all lands of the Nile valley and the delta and the new lands that are suitable for modern irrigation systems while preserving the governorates of the northern delta in the northern regions so that seawater does not interfere with the underground water resources. The proposed duration of the program's implementation is ten years and will take place in three phases.

Already 1.5 million feddans are classified as modernized on New and Old Lands. An additional 700,000 feddan of new lands remain to be converted, and 2 million feddan in the north will not be converted to modern irrigation to prevent the saline intrusion line from advancing further south. The Northern belt of the Nile delta is where traditional rice irrigation continues to be practised in order to avoid the saline intrusion line from advancing further inland. Currently, some 3,720,000 feddan are projected in addition to already converted 280,000 feddans. About 10 % of the potential area (320,000 feddans) is currently under sugarcane in Upper Egypt (mainly in Menia, Suhag, Qena, Luxor and Aswan). Although sugarcane requires much water, it will be maintained to produce continuous supplies for sugarcane mills that are important sources of employment in these poor governorates.

The MWRI and MALR have prepared a shared vision of the modern irrigation system to include means of sprinkler or drip Irrigation and subsurface irrigation to be applied at the fringes of the Nile delta and valley. The percentage of land irrigated by modern irrigation in Egypt now is about one million feddans, representing 10% of the total irrigated area.

The role of the MWRI is to restrict areas that violate the prescribed irrigation type in the new lands, to stress the application and collection of fines for wasting water, which is currently worth 3600 EGP per feddan, and to consider increasing them in the future, and finally to conduct the rehabilitation of canal networks and branches leading to the targeted areas, as well as providing continuous irrigation sources and locating wells and their safe discharges.

MALR is carrying out an intensive awareness campaign to increase water awareness among farmers, inventory valves and design internal irrigation networks, conduct an inventory of years to determine

the required water disposal, and prevent the distribution of fertilizers, Seeds and chemicals to violators.

The most relevant project to report is the ***On-Farm Irrigation Development in the Old Lands (OFIDO)***. However, the table below also gives an overview of other related projects.

TABLE 2-10 OVERVIEW OF PROJECTS RELATED TO ON-FARM IRRIGATION DEVELOPMENT IN EGYPT

Project	Description	Objective	Results
Irrigation Improvement Project (IIP)	In the late 1970s, the Egyptian Water Use and management Project (EWUP) was implemented and introduced the transition (at least in qualitative terms) from water supply management to water demand management and emanated the concept underlying the IIP. The IIP started a new phase of the irrigation modernization journey. The project used new irrigation concepts (continuous flow) and new tools (automatic control structures) to achieve targets.	Main objectives: - improve the water use efficiency - enhance the equity of water distributions between and within the branches. The IIP represented the foundation for continuing the irrigation modernization process in Egypt through additional important projects, building incrementally on top of each other.	- The establishment of WUAS and continuous flow were considered key in this Project. - Farmers finally received a role in water distribution. - All submitted reports in this program stated that the continuous flow was not implemented fully in almost all branch canals. - Water-saving could not be documented in a robust statistical manner, and on-farm irrigation efficiency seemed not to increase.
Integrated Irrigation Improvement and Management Project (IIIMP)	The "successor of IIP" would provide the introduction of a framework for integrated water resources management, support the piloting of institutional reforms, together with support for the rehabilitation of irrigation, drainage and pumping stations and removal of system bottlenecks in the major canals in three command areas in the Nile Delta in Upper Egypt.	The aim was to assist the implementation of measures to ensure the efficient and sustainable use of the country's water and land resources. The project had different components: I. Improved and Integrated Water Management, including components related to the implementation of irrigation and drainage rehabilitation, improvement and modernization works and programs at all levels of the selected command areas, including main canal system, branch canal) and mesqas. II. Improved On-Farm Water Management,	With a total cost estimated USD 120 Million, the Project had an implementation period between 2007 and 2016. Unfortunately, the project implementation was delayed because of the political unrest in 2011 and 2013.

Project	Description	Objective	Results
		III. On-farm water control and irrigated agriculture practice demonstrations	
Farm-level Irrigation Modernization Project (FIMP)	On-farm irrigation modernization was the focus of FIMP, which could maximize returns from the previous heavy investments in the upstream systems.	The development objective was to increase agricultural profitability and improve equity in access to higher-quality water for up to 140,000 small-scale farmers on up to 200,000 feddans in the command areas. This objective was expected to be achieved through structural improvements to the irrigation network and farmer support services, focusing on areas where upstream irrigation improvements, both physical and institutional, had occurred and were fully functional, thanks to previous Bank-financed projects.	The Project had a contribution of a total of USD 180 Million. It was carried out by MALR and had an implementation period from 2012 and 2017.
On-Farm Irrigation Development Project (OFIDP)	MALR Sustainable Agricultural Development Strategy 2030 was given effect through IIP to benefit approximately 1.7 million feddan between 2007 and 2017. The OFID project was co-financed by the Organization of the Petroleum Exporting Countries (OPEC) Fund and the GOE for a total cost of USD 43 million. The overall cost per feddan has been appraised at USD 667.	The goal was to help develop and maintain the natural resources base (such as land and water) through improved irrigation and to reclaim new land. A target within the irrigation improvement program was to increase agricultural production by 12% annually.	The project proposed to strengthen and support the efforts of GOE to modernize farm-level irrigation on about 55 000 feddan (23 100 ha). This was to be achieved through investments in four components, including Marwa Improvement and Farm Irrigation Management. The OFID Project specifically focused on Marwa improvement (not mesqa) and was intended to augment prior projects in which branch canals and mesqa pump stations were already modernized.
On-Farm Irrigation	An agribusiness development program funded by the	The project worked towards four objectives:	The Project duration, still ongoing, was

Project	Description	Objective	Results
Development in the Old Lands (OFIDO)	International Fund for Agricultural Development (IFAD), whose goal was to improve the livelihoods of the rural poor in the project area through targeted interventions fostering the enhancement of farms production potential and the raise of households' income. The project was implemented in eight governorates on a total of 31 916 feddan, targeting a population primarily composed of smallholders holding an average of three feddan.	1. Improve the irrigation network. 2. Improve agricultural productivity through an appropriate integrated research and extension system. 3. Support for marketing for smallholders and landless. 4. Support for job creation, income-generating and micro and small enterprises.	planned between 2009 and 2020 with a total cost of US$ 92.16 million and an expected cost per feddan of USD 3,138. The project assessment revealed the following results (See "Results" below).

This Project is funded
by the European Union

Results of the Development in the Old Lands (OFIDO)

- Transforming traditional earth mesqas / marwas to buried pipe systems resulted in land gain over the pipes. The gained area is converted to production areas. Further benefits include the reduction of weeds and reduced maintenance costs.
- Conveyance efficiency had a significant effect on lowering irrigation costs.
- Irrigation improvement increased yields, but further on-farm management development is needed to use this. The improvement significantly decreased the duration and number of irrigation turns.
- Comparison between electric and diesel pumps showed that electric pumps have considerable potential for energy cost saving. The cost difference between improved (electric) and non-improved *mesqas* (diesel pumps) ranged between 7.51 and 27.62% in Assuit and Sohag Governorates and 27 and 30% in Kafr El-Sheikh. However, the electrical faults may represent a significant drawback if frequently occurring.
- Profitability of the main crops remained low: around 3 434 EGP per feddan for Sorghum, 5 526 EGP per feddan for Maize, 8 695 EGP per feddan for Rice. Farm areas are small, therefore, profitability must be improved, e.g., by optimizing cost structure.
- Forage productivity directly impacted livestock production since most farmers produce in mixed-farm systems (crop-livestock). Forage productivity has also significantly impacted women in agriculture. Therefore, improving this is important in irrigated agriculture development.
- The project reached around 73% of its initial design targets for modernizing the irrigation system, provided loans for 9,888 SMEs, created more than 19,000 jobs, and trained and established 121 Marketing Associations. Strengthening the water user organizations or related to participatory farming system research and extension is still missing.
- Farmers in the command area of the completed schemes were satisfied with the work and reported significant reductions in the cost of pumping water, time used for irrigation as well as increased efficiency of the system and convenience.
- Furthermore, the result showed that the beneficiaries had experienced a savings of 20% in the cost of irrigation (converting from diesel to electricity).
- The project indicates net positive gains: the new irrigation system had a Net Present Value of USD 5 million over the next ten years (10% discount rate) and a Return on Investment of 14%, which that.

2.5 RECOMMENDATIONS FOR IMPROVEMENT

Some recommendations for improvement can be found below:

- The proper management of water could achieve a corresponding increase in water availability and efficiency through more effective on-farm water management practices, changes in cropping patterns toward crops that use less water, the introduction of improved irrigation systems, and the reuse of drainage water and treated sewage.

- A policy priority would improve existing lending arrangements with the EBA, based on improved due diligence of loan applications and supporting business plans provided by former groups and endorsed by certified engineers and WUAs. In addition, it is recommended to consider a more substantial role of the private sector financing solutions provided by international irrigation industries.

3. SUCCESSES AND FAILURES

Major Lessons Learned from Irrigation Improvement Projects in Egypt

- Several benefits were obtained, including improved equity of water distribution among farmers, increased land and water productivity, increased farmers' income, higher land value in some cases, reduced overall cost of irrigation, improved overall reliability of the delivery system and easier pumping operations, easier irrigation practices down to farm level, and more crop diversifications.
- Several measures were demonstrated of high value for the process of Irrigation Modernization, including the establishment of Branch Canal and mesqa WUAs, extensive involvement of farmers at every stage of project design and implementation, the adoption of Farmers Field School with demonstration fields, and capacity development and training in general.
- However, there were several challenges and obstacles to successfully implementing these projects. The observed negative outcomes include no water saving, the failure to implement continuous flow, the lack of Branch Canal control and measurement equipment, poor design of the new electric pumping stations further aggravated by the random and often frequent black-out, the under-performance of the project implementation contractors and the lack of after-sale and maintenance services of the various hardware (pumps, valves, pipes, etc.). In this case, capacity building of "last mile" retailers is an essential component of irrigation modernization.
- The 'soft' components of the projects indicated the need to institutionalize the Branch Canal WUAs (BCWUAs) and the insufficient capacity development for WUAs' farmers and engineering. However, the cost recovery appeared low in several cases.
- All projects attempted to implement Irrigation Modernization, in different areas, with similar approaches, though not in a complementary way. Furthermore, some were under the responsibility of the MWRI, and some were under the MALR. Major peculiarities of these modernization projects included the conversion of open/earth canals into buried pressure uPVC pipelines, land levelling in some cases and reshaping of field drains in others, conversion of diesel pumps into electric ones, and establishing of the single-point lifting pumping station at mesqa level (rather several individual pumps), the establishment of continuous flow, strengthening of irrigation advisory service and on-farm demonstration fields. Higher institutional collaboration between the two Ministries is advocated.

The lessons provided by these projects will be precious in developing additional demonstration projects and further scaling up Irrigation Modernization in the Nile Delta and Valley.

4. GENERAL OUTCOMES OF THIS REVIEW

Agriculture in Egypt remains an important source of economic wealth for the country. Over 30% of the people in Egypt remain dependent on farming for their living, and more than 30% of the population remains below the poverty line, with an additional 13% just above it. High levels of subsidy are used for many basic commodities. Current challenges include accelerating inflation (more than 23% per year in mid-2008), a high fiscal deficit and rising unemployment.

Agricultural Water Supply

By 2037, the amount of water available for agriculture is predicted to fall to 59.6 BCM. Gains in the overall freshwater availability are more than offset by the increased supplies to domestic and industrial usage. As a result, the area irrigated will remain quite similar to 2015. Although additional lands will have been reclaimed, existing lands will also be lost due to urbanization, reducing the net increase in the agricultural area[13]. Therefore, the water allocation per feddan will fall by roughly 10% to near 6,200 m3/feddan/year, equivalent to a water layer of 1,475 mm.

It is not foreseen that a significant change in overall irrigation efficiency will occur as there is little scope to enhance the overall efficiency due to the high rate of reuse. A 100% efficiency is not achievable, as soils need to be leached, and accumulated salts must be directed to the sea. Reusing the leached water (drainage) and municipal sewage water is already an established practice.

Therefore, farm households or agricultural enterprises will have to do with a 10% reduction in the amount of water available to their crops. This is challenging due to the expected rise in temperature, resulting in higher potential crop evapotranspiration. As a result, farmers will have to choose crops or cultivation systems that consume less water, reduce cropping intensity, or accept sub-optimal production.

Economic outlook

Concerns remain regarding households' welfare as real incomes have not recovered from the previous two years' spike in inflation. Egypt has implemented several social safety net measures, including scaling up the existing cash transfer program and adding an additional 60,000 households. The government has also introduced a one-time-off cash payment to irregular workers impacted by the COVID-19 outbreak, targeting 1.5 million workers with EGP500/month for three consecutive months

A new generation of agricultural water policies and investments, built on the principles of sustainability, innovation and private sector engagement, is required for the Arab region to achieve the SDGs. Valuing water, accelerating agriculture sector transition and targeting efficient social protection are important strategic directions to achieve the SDGs.

From the 1990s onwards, water investment attention in the Arab region shifted from large-scale irrigation systems (e.g. canals) to rehabilitating existing infrastructure, community-based irrigation management and institutional development, primarily due to increased emphasis on community-driven development, participatory water management and decentralization.

[13] NWRP water balance studies: 2015 8.7 million feddan; 2037 9.6 million feddan

Before focusing on investment schemes, it is important to note that farmers and policymakers need to understand the meaning of irrigation for them, the challenges and the options available. For instance, while irrigation at a national level can have approaches of irrigation efficiency as a part of national development strategy for food security, policy and good governance drive improvement, irrigation on farms can have methods of irrigation efficiency as farm irrigation efficiency, optimizing technologies (and water management - *more crop per drop*), adopting best practices and smart irrigation.

It is also important to understand the main investors in the agricultural sector and whether it is enough. It should be noted that agriculture receives proportionally less from public spending than its own contribution to GDP, and most Arab countries are not spending enough on agriculture.

The cost of not investing should not be underestimated, considering the economic losses of significant water losses due to climate change (6-10 % of regional GDP by 2050) an adverse impact on social and environmental wellbeing.

Public spending is still the key funding source (both for new and recurrent investments). Still, it is often insufficient to even meet recurrent management, operation and maintenance costs.

Private investors, including farmers, play a significant role in agricultural water investments, both in irrigation expansion through groundwater wells and surface irrigation schemes' operation and maintenance.

There is a growing awareness of the need for national governments to become better enablers of private investment, including exploring options for private sector involvement in the construction, operation and maintenance of irrigation and drainage infrastructure.

Innovative financing mechanisms and partnerships are often key to delivering the necessary investments. They must focus on maintaining essential services and facilitating emergency relief efforts while building capacity and promoting sustainable water use. One-off subsidies to maintain or quickly restore critical infrastructure assets and services and retain skilled staff in irrigation authorities are recommended to sustain basic services.

Applying advanced technology and innovations in the agricultural sector has potentially profound implications for producers and investors. Several below examples can be considered in the medium-term to create opportunities for investment in agricultural water management:

- The use of solar energy for groundwater pumping, if combined with appropriate governance mechanisms, can result in enhanced irrigation yield and achieve carbon neutrality.
- Water productivity can be enhanced via integrating emerging digital technologies with agricultural water management practices; however public sector's role as an enabler and regulator of digital agricultural technologies is strongly needed.

If two critical aspects of agricultural water management, which are irrigation service delivery to on-farm sustainable practices, were better managed to maximize the use of water, it would lead to a more stable food production and benefits to the broader economy (e.g. 0.5 % improvement of regional GDP)

Global analyses suggest that irrigation investments positively affect agricultural growth and poverty and have a strong multiplier effect on local economies (up to two to three times direct benefits). For example, world Bank irrigation and drainage projects held in the region from 1994 to 2018 show that

the return of agricultural investments averages between 12-22 % for Egypt's improved and farm-level irrigation modernization projects, respectively.

Agricultural water investments in the region are expected to focus on modernization and climate change adaptation. There can be potential for investments by the public sector in the modernization of irrigation infrastructure in the coming years with the below focus area:

- Investments for technical and managerial modernization of irrigation schemes considering institutional reforms. It will positively impact water resources' sustainability, equability, and irrigation service delivery. Piloting innovations can help to accelerate the decision of investment. Technological advances for improved quality of water delivery can support farmers in transitioning towards modern farming systems
- Private sector appetite and new market opportunities for farmers can be enhanced via improving irrigation service quality and delivery like irrigating high-value crops.

In Egypt, there is a low public investment and budget execution efficiency, and as estimated by World Bank, up to 10 percent of total public expenditure was absorbed by irrigation water services in the 2000s (REF: World Bank. 2005. Integrated irrigation improvement and management project. Project Appraisal Document. Washington, DC.). Moreover, management, operation and maintenance budgets go to administrative overheads instead of supporting a large irrigation bureaucracy (REF: United Nations Development Programme (UNDP). 2014. Water governance in the Arab region: managing scarcity and securing the future. New York, USA. p. 43.).

Poor surface irrigation systems in Egypt confirm the inadequate spending (therefore large deficits and low financial viability of irrigation authorities) on agricultural water. This situation directs farmers to use electricity/diesel subsidies for pumping mostly illegal groundwater.

Among other Arab countries, Egypt has the lion’s share (USD 981 M between 2008-2017) in international aid for agricultural water. The contribution of multilateral donors, such as international financial institutions and regional development banks, has also been increasing in recent years. Although international aid is unstable and lower than private investments, it can be promoted as it can support innovations and impact prioritization.

In general, a large portion of the public and development-assisted investment focused on large-scale irrigation, with private sector investors for groundwater irrigation ranging from smallholder farmers to large private landowners (REF: European Bank for Reconstruction and Development (EBRD) & (FAO 2017). Best practices in irrigation financing. Options for EBRD intervention. London, EBRD). Although farmer-driven investment is key to agricultural water management in this region, consequences such as groundwater depletion related to uncoordinated private irrigation development should also be recognized.

PPPs in irrigation are still evolving, and active public sector collaboration is needed to help projects succeed. Because the required level of investment is much greater than what can reasonably be recovered through water user fees alone. There are few such examples in Arab regions where they have limited success. PPPs work better with new developments rather than with existing schemes. Financial, legal and political aspects, including O&M costs, performance monitoring and public opinion, need to be carefully considered in the planning stages for PPPs to be viable.

Although PPPs in Egypt have existed in many areas such as sanitation, wastewater treatment, energy, health, etc., the PPP approach in agricultural water is not described. The main factors driving the interest in PPPs can be some irrigation schemes' poor performance and lack of sustainable and adequate funding for maintenance, poor public finance, and perhaps the most pronounced driver, the assumption that the private sector can bring innovation and modern management practices, and as a result service delivery will be improved leading to improved crop production and incomes. This will enhance the capacity and willingness to pay irrigation service fees which cover the actual operation and maintenance costs. Especially non-commercial smallholders have less ability and willingness to pay for water. Property rights can be another risk to be considered in the PPP model.

Other financing alternatives can be regional foundations (e.g. Arab Foundations Forum), private agribusinesses and venture capital high-impact investments (for science-based agricultural modernization projects of small farmers). Even green bonds for the modernization of irrigation schemes to secure climate-resilient development targets (as issued by the World Bank in Tunisia in the 2000s for the water sector, including irrigation investments) are possible alternatives.

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